Quality Assurance/ Sampling and Analysis Project Plan

Sauget Area 1
Dead Creek Sediment Removal Action Mitigation Plan

Solutia Inc.
Sauget, Illinois

November 2002

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

SOLUTIA INC. – SAUGET, ILLINOIS
SAUGET AREA DEAD CREEK SEDIMENT REMOVAL ACTION

QUALITY ASSURANCE/SAMPLING AND ANALYSIS PROJECT PLAN

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Laboratory (TBD)

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Preface

This SRA Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP) supplements the Sauget Area 1 Dead Creek Sediment Removal Action Mitigation Plan (SRAMP) and presents the sampling and analytical methods and procedures that will be used during implementation of select actions at the site.

This QA/SAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) "Test Methods for Evaluating Solid Waste, SW-846" (USEPA, 1996);

- USEPA's guidance document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Operations," EPA-QA/R-5 (USEPA, 2001), which replaces QAMS-005/80 "Interim Guidance and Specifications for Preparing Quality Assurance Project Plans" (USEPA, 1980); and

- The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual (USEPA, 1991).

Information contained in this QA/SAPP has been organized into the following sections:

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Details are provided in the subsequent sections. This document also contains pertinent information from the SRAMP related to measuring and evaluating the analytical data.

1. Project Organization

1.1 Project Organization

The Sauget Area 1 Dead Creek Sediment Removal Action (SRA) at the Solutia Inc. facility in Sauget, Illinois will require integration of personnel from the organizations identified below, collectively referred to as the "project team." A detailed description of the responsibilities of each member of the project team is presented below.

1.1.1 Overall Project Management

On behalf of Solutia Inc. (Solutia), Blasland, Bouck & Lee, Inc. (BBL), has overall responsibility for the SRA activities. BBL personnel will perform related sampling activities. In addition, BBL will evaluate data and prepare the deliverables as specified in the SRA Mitigation Plan (SRAMP). Project direction and oversight will be provided by Solutia. Oversight in the field may also be provided by Solutia. A list of key project management personnel is provided below.

Title	Company/Organization	Name	Phone Number
Project Manager	Solutia Inc.	Bruce S. Yare	(314) 674-6370
Project Director	Solutia Inc.	Richard S. Williams	(630) 579-0275
Project Officer	Blasland, Bouck & Lee, Inc.	Alan Fowler	(978) 921-0442
Project Manager	Blasland, Bouck & Lee, Inc.	David Ludwig	(410) 295-1205
Field Manager	Blasland, Bouck & Lee, Inc.	Todd Merrell	(315) 446-9120
Project Manager	USEPA	TBD	TBD

1.1.2 Task Manager

The staff performing the investigations and site activities will be directed by representatives of the project team. The personnel responsible for each of the site activities are listed below.

Title	Company/Organization	Name	Phone Number
Sediment Investigation Task Manager	Blasland, Bouck & Lee, Inc.	Steve Truchon	(978) 921-0442
Survey Task Manager	Blasland, Bouck & Lee, Inc.	Tom O'Rourke	(315) 446-9120
Analytical Task Manager	Blasland, Bouck & Lee, Inc.	Laurie A. Indick	(315) 446-9120
Health and Safety Manager	Blasland, Bouck & Lee, Inc.	Jay Keough, C.S.P.	(609) 860-8072

1.1.3 Analytical Laboratory Services

[Note: A laboratory will be identified and responsible management personnel cited here.]

Analytical laboratory services for environmental samples associated with the SRA will be provided by a qualified laboratory (to be determined). Laboratory management personnel are listed below.

Title	Company/Organization	Name	Phone Number
Laboratory Director	TBD		
Laboratory Project Manager	TBD		

1.1.4 Quality Assurance/Data Management Staff

The following quality assurance/data management personnel have been assigned to this project:

Title	Company/Organization	Name	Phone Number
Quality Assurance Manager	Blasland, Bouck & Lee, Inc.	Laurie A. Indick	(315) 446-9120
Quality Assurance Manager	Laboratory (TBD)	TBD	TBD
Quality Assurance Manager	USEPA	TBD	TBD
Database Administrator	Blasland, Bouck & Lee, Inc.	Michael J. Shivell	(315) 446-9120
Data Validator	Blasland, Bouck & Lee, Inc.	Dennis Capria	(315) 446-9120

1.2 Team Member Responsibilities

1.2.1 Solutia Inc.

Project Manager

Responsibilities and duties include:

- Provide overall direction of site actions;
- Direct BBL; and
- Review BBL work products, including data, memoranda, letters, reports, and all other documents transmitted to the United States Environmental Protection Agency (USEPA).

1.2.2 Blasland, Bouck & Lee, Inc.

Project Officer

Responsibilities and duties include:

- Oversee BBL work products; and
- Provide BBL approval for major project deliverables.

Project Manager

Responsibilities and duties include:

- Manage and coordinate the project as defined in the Work Plan, with an emphasis on adhering to the objectives of the site action;
- Review documents prepared by BBL; and
- Assure corrective actions are taken for deficiencies cited during audits of site activities.

Task Managers

The SRA will be managed by Task Managers as set forth in Section 1.1.2. Responsibilities and duties of each Task Manager include:

- Manage relevant day-to-day activities;
- Develop, establish, and maintain files on relevant site activities;
- Review data reductions from the relevant site activities;
- Perform final data review of field data reductions and reports on relevant site activities;
- Assure corrective actions are taken for deficiencies cited during audits of relevant site activities;
- Perform overall Quality Assurance/Quality Control (QA/QC) of the relevant portions of the site activities;
- Review relevant field records and logs;
- Instruct personnel working on relevant site activities;
- Coordinate field and laboratory schedules pertaining to relevant site activities;
- Request sample bottles from laboratory;
- Review the field instrumentation, maintenance, and calibration to meet quality objectives;

- Prepare reports pertaining to relevant site activities; and
- Maintain field and laboratory files of notebooks and logs, data reductions, and calculations, and transmit originals to the Project Manager.

Field Personnel

Responsibilities and duties include:

- Perform field procedures associated with the investigations as set forth in the Work Plan;
- Perform field analyses and collect QA samples;
- Calibrate, operate, and maintain field equipment;
- Reduce field data;
- Maintain sample custody; and
- Prepare field records and logs.

Quality Assurance Manager (QAM)

Responsibilities and duties include:

- Review laboratory data packages;
- Oversee and interface with the analytical laboratory;
- Coordinate field QA/QC activities with Task Managers, including audits of removal action activities, concentrating on field analytical measurements and practices to meet data quality objectives;
- Review field reports;
- Review audit reports;
- Prepare interim QA/QC compliance reports; and
- Prepare a QA/QC report in accordance with United States Environmental Protection Agency (USEPA) guidelines, which includes an evaluation of field and laboratory data and data usability reports.

1.2.3 Laboratory (to be determined)

General responsibilities and duties of the analytical laboratories include:

- Perform sample analyses and associated laboratory QA/QC procedures;

- Supply sampling containers and shipping cartons;
- Maintain laboratory custody of sample; and
- Strictly adhere to all protocols in the QA/SAPP.

Project Manager

Responsibilities and duties include:

- Serve as primary communication link between BBL and laboratory technical staff;
- Monitor workloads and ensure availability of resources;
- Oversee preparation of analytical reports; and
- Supervise in-house chain-of-custody.

Quality Assurance Manager

Responsibilities and duties include:

- Supervise the group that reviews and inspects all project-related laboratory activities; and
- Conduct audits of all laboratory activities.

1.2.4 United States Environmental Protection Agency (USEPA)

Project Manager

Responsibilities and duties include:

- Provide USEPA approval of the Work Plan, supporting documents, and future deliverables; and
- Provide oversight during performance of the site activities.

Quality Assurance Manager

Responsibilities and duties include:

- Review and approval of the QA/SAPP;
- Review of the QA/QC portion of any submitted report;
- Monitor progress of the removal actions;

- Ensure that all activities are performed in compliance with applicable federal and regional requirements; and
- Perform field and laboratory audits, if necessary.

2. Project Background

The following summarizes background information for Dead Creek and Borrow Pit Lake. This information was compiled for the *Sauget Area 1 Support Sampling Plan* (O'Brien & Gere, 1999) and the *Sauget Area 1 Dead Creek Sediment Removal Action Mitigation Plan* (Solutia 2002).

2.1 Site Location and Description

Borrow Pit Lake is located in Sauget and Cahokia, just south of East St. Louis, Illinois (Figure 1). The lake basin is nearly a mile long (5,200 feet) and on average, approximately 500 feet wide. Borrow Pit Lake receives surface waters on its southern end from Dead Creek (Segment F). Lake hydrodynamics are dominated by the Mississippi River flood cycles. Normally, during late summer and winter months of the year, Dead Creek and Borrow Pit Lake are dry with scattered areas of standing water or ice (Woodlot Alternatives, 2001).

2.2 Site History and Summary of Activities

On August 29, 2001, USEPA Region 5 issued an Amended Administrative Order (Docket No. V-W-99-C-554; hereafter, "The Order") for a time-critical sediment removal action in Dead Creek, a 3.5 mile long stream located in Sauget, and Cahokia, St. Clair County, Illinois. As required by the Order, approximately 46,000 cubic yards of impacted sediment were removed from Creek Segments B, C, D, E and F, Site M and the lift station sump where Dead Creek discharges into Old Prairie du Pont Creek. Excavated sediments were transferred to a RCRA and TSCA-compliant containment cell constructed adjacent to the west bank of Dead Creek Segment B just north of Judith Lane. Sediment transfer was completed in January 2002. A temporary plastic cover was installed in the cell to isolate the impacted sediments from storm water. Storm water falling on the cell was contained and treated using granular activated carbon prior to discharge to Creek Segment B.

In addition to installing the cap on the containment cell, Section 3 of the Order, *Work to be Performed*, identified several additional work elements involving characterization of lake sediments, Section 3.C of the Order calls for a Mitigation Plan.

This QA//SAPP specifically addresses the sampling and analysis protocols for a sediment investigation in Borrow Pit Lake to comply with the Order.

3. Project Description

This section describes the investigation activities to be conducted in the Borrow Pit Lake. The two sampling activities that will be performed as part of this investigation are: 1) surface sediment characterization, and 2) sub-surface sediment characterization.

Sampling protocols to be followed during the investigation activities are detailed in Section 8 of this QA/SAPP. Samples collected during the investigation will be analyzed in accordance with USEPA Method 1630 (modified) and USEPA SW-846 Method 7471. Table 1 presents a list of the constituents that will be analyzed for samples collected as part of the Borrow Pit Lake investigation. A description of the sediment sampling effort is presented below.

Sediment sampling in the Borrow Pit Lake is being planned for the winter months of 2003. The purpose of implementing the sampling described in this QA/SAPP during these months is to facilitate sampling of the sediment. Sampling during spring or summer would increase the hazards associated with moving around the Borrow Pit Lake. In the presence of surface water, sampling would need to be conducted by boat or wading. In the absence of surface water and during warmer months, sampling would need to be conducted using mud shoes or planking to avoid sinking in the unconsolidated sediment. Sampling during the winter months ensures that the sediments will be sufficiently stabilized as to pose fewer hazards to the field sampling team.

3.1 Sample Location

Coordinates for each sampling location will be established from existing topographic surveys prior to undertaking the sampling effort. This will be accomplished by overlaying a 200 ft by 200 ft grid pattern over portions of the Borrow Pit Lake that are downstream of the confluence with Dead Creek Segment F. Similarly, a 300 ft by 300 ft grid pattern will be overlayed on portions of the Borrow Pit Lake that are upstream of the confluence of Dead Creek Segment F. The overlays will result in a series of grid cells that will each have coordinates that will aid in targeting a sample location. A Differential Global Positioning System (DGPS) unit will be used in the field to navigate to each sampling location based on these pre-established coordinates. A field log book will be used to record time, date and other relevant details of the sampling effort (Sections 6 and 16).

Sampling methods, procedures and protocols are the same as those used for the *Sauget Area 1 Support Sampling Plan* (O'Brien & Gere, 1999) and in the *Sauget Area 1 Dead Creek Sediment Removal Action Mitigation Plan* (Solutia 2002). Where appropriate, the procedures and protocols from these plans are summarized in relevant sections of this QA/SAPP.

3.2 Sample Collection

Once located, a sample will be collected from the center of each grid cell at a depth of 0 to 6 inches below ground surface to characterize the biologically active zone, for a total of 60 surface sediment samples (Figure 4-1). Samples will also be collected at every odd-numbered grid cell (50 percent of the sampling locations) from a depth of 6 inches to the bottom of the sediment profile, which is typically 8 to 15 inches thick, to characterize the "sub-surface sediments of the Borrow Pit Lake substrate. Combined, the total number of sediment samples is 90 samples.

Sediment samples will be collected using a manual push-type sediment core sampler. In the event there is ice at the sample location, and ice auger will be used to access sediments with the sampler. The sampler consists of a PVC barrel, polycarbonate (Lexan®) liner, check valve, extension rods, and a "T" handle. A liner will be placed into the bottom of the tube and secured in place. The sampler will then be pushed into the sediment, collecting a sediment sample from 0 to 18 inches below the top of the sediment. Sediment will then be pulled up; creating a slight vacuum that closes the check valve. The tube will be removed from the sampler, and the 0 to 6 inch horizon sectioned accordingly. At odd-numbered grid cells, the remaining sediment (6 to 18 inch) horizon will be collected as a sample. In the event of sampler refusal at less than 18 inches, the total sample depth will be recorded and the sample taken for analysis.

All samples will be prepared and placed into the sample containers in accordance with Standard Operating Procedures (Appendices A and B). Sample containers will be placed on wet ice in coolers. Chain-of-custody procedures will be followed. After each sampling location or when all decontaminated sampling equipment has been used, sampling equipment will be decontaminated according to the procedures outlined below.

3.3 Decontamination of Sampling Equipment

The following procedures will be used for sampling equipment requiring decontamination is needed:

- Brush-wash reusable equipment in a bucket or tub using a trisodium phosphate (TSP) or other commercial detergent solution (2 lb of TSP per 10 gal of clean water). Completely brush the entire exterior surface of the article undergoing decontamination. Wash interior wetted surfaces as required.
- Rinse the item with copious quantities of potable water, followed by a distilled water rinse. Rinse reusable sampling equipment used to collect environmental media for metals analysis in a dilute nitric acid solution, followed by a distilled water rinse.
- Air-dry sampling equipment on a clean, non-plastic surface in a well-ventilated, uncontaminated environment. If the sampling device is not to be used immediately, wrap it in aluminum foil and place it in a plastic bag or storage container.

Contain rinse water in a plastic tub with a lid. Empty the contents of this tub daily into a 55 gallon drum located at the IDW storage area.

4. Quality Objectives and Criteria for Measurement Data

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site-related activities and are based on the end uses of the data to be collected. Preliminary DQOs were identified to ensure that the data generated during field investigations will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives.

A DQO summary for the sampling investigation efforts is presented below. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data allows rapid identification and quantitation, although the quantitation can be relatively imprecise. This objective for data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

It is anticipated that both the screening and definitive data categories will be used during the investigation. Field parameters (i.e., turbidity, conductivity, temperature, and pH) that will be obtained during surface water sampling to qualitatively interpret other site data will be determined using screening techniques. All remaining parameters will be determined using definitive techniques.

For this project, three levels of data reporting have been defined. They are as follows:

Level 1 - Minimal Reporting: Minimal or "results only" reporting is used for analyses which, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 - Modified Reporting: Modified reporting is used for analyses which are performed following standard USEPA-approved methods and QA/QC protocols. Based on the intended data use, modified reporting may require some supporting documentation but not, however, full "CLP-type" reporting.

Level 3 - Full Reporting: Full "CLP-type" reporting is used for those analyses which, based on the intended data use, require full documentation.

The reporting levels for the individual sampling tasks described herein are presented in the following subsections.

4.1 Surface Sediment Characterization

Data Use

The sample data will be used for site characterization.

Data Type

Water depth, sediment thickness, and survey data will be collected for all samples. In addition, samples will be collected for laboratory analysis of total and methyl mercury.

Data Quantity

The sample quantities and parametric requirements are summarized in Table 1. Additional information regarding the choice of specific sample collection locations and required analyses can be found in the SRAMP and Section 7 of this document.

Sampling and Analytical Methods

Sampling methods will be as specified in Section 8. The analytical methods are as specified in Section 10. Reporting for total and methyl mercury will be Level 3 (as defined previously).

Measurement Performance Criteria

Precision and accuracy quality control limits for chemical constituents that are used during data review to assess analytical performance are included in Table 23. Reporting limits are presented in Table 3

Data representativeness is addressed by the sample quantities and locations identified in the Work Plan. Data comparability is intended to be achieved through the use of standard USEPA-approved methods. Data completeness will be assessed at the conclusion of the analytical activities.

4.2 Subsurface Sediment Characterization

Data Use

Subsurface sediment data will be used for site characterization.

Data Type

Subsurface sediment from the odd-numbered grid sections will submitted for laboratory analysis of total and methyl mercury.

Data Quantity

The sample quantities and parametric requirements are summarized in Table 1. Additional information regarding the choice of specific sample collection locations and required analyses can be found in the SRAMP and Section 7 of this document.

Sampling and Analytical Methods

Sampling methods will be as specified in Section 8. The analytical methods are as specified in Section 10. Reporting for total and methyl mercury will be Level 3 (as defined previously).

Measurement Performance Criteria

Precision and accuracy quality control limits for chemical constituents that are used during data review to assess analytical performance are included in Table 2. Reporting limits are presented in Table 3.

Data representativeness is addressed by the sample quantities and locations identified in the Work Plan. Data comparability is achieved through the use of standard USEPA-approved methods. Data completeness will be assessed at the conclusion of analytical activities.

5. Special Training Requirements/Certification

In compliance with the Occupational Safety and Health Administration's (OSHA) final rule, "Hazardous Waste Operations and Emergency Response," 29CFR§1910.120(e), all personnel performing SRA activities at the site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

6. Documentation and Records

6.1 General

Sediment samples will be collected as described in the SRAMP and Section 8 of this document. Detailed descriptions of the sample designation system, documentation and reporting requirements are presented below.

6.2 Sample Designation System

6.2.1 Sample Codes

A sample designation code will provide each sample with a unique "name". This alphanumeric system will apply to all samples that are to be transmitted to the laboratory for analysis. Samples will be designated:

- BPL (indicating that the sampling is from the Borrow Pit Lake component of the project)
- HGSED (indicating a sediment mercury sample)

A two-digit code will designate the sample grid number:

- 01 through 60.
- 61 through 70 reserved for field duplicates.
- 71 through 80 reserved for rinse blanks.

Sample depth will be indicated by:

- 0 - 0.5 ft.
- 0 – (bottom depth of sample) ft.

Additional sample volumes collected for matrix spike (MS) and matrix spike duplicate (MSD) analysis will be noted on the chain-of-custody forms, and the associated additional sample containers will be labeled with the appropriate suffix (MS or MSD). Field duplicate will be designated, sequentially, with grid numbers 61 through 70 and will otherwise be in no way be distinguishable by the laboratory as duplicate samples. Rinse blanks will be numbered, sequentially, with grid numbers 71 through 80.

6.3 Field Documentation

Field personnel will provide comprehensive documentation covering various aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes of a record that allows reconstruction of field events to aid in the data review and interpretation process. Documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include:

- Daily Production Documentation - A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- Sampling Information - Detailed notes will be made as to the exact sampling location, physical observations, and weather conditions (as appropriate).

- Sample Chain-of-Custody - Chain-of-custody (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by BBL's field personnel responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in Appendix B.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- Field Equipment, Calibration, and Maintenance Logs - To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

6.4 Laboratory Documentation Files

6.4.1 Laboratory Project Files

The laboratory will establish a file for pertinent data. The file wi l include correspondence, faxed information, phone logs, and COC forms. The laboratory will retain project file s and data packages for not less than a period of 5 years.

6.4.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document important aspects of the work, including the associated quality controls. As such, logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions. Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QA/SAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

6.4.3 Computer Tape and Hard Copy Storage

All electronic files and deliverables will be maintained on magnetic tape or disk for not less than five years; hard copy data packages (or electronic copies) will be maintained in the files for five years.

6.5 Data Reporting Requirements

6.5.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the SRAMP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Where appropriate, field data forms and calculations will be processed and included in appendices to a Site Action Report (when generated). The original field logs, documents, and data reductions will be kept in the project file at the BBL office in Syracuse, New York.

6.5.2 Laboratory Data Reporting

The laboratory is responsible for preparing full CLP-equivalent data packages for all total and methyl mercury data, reduced data packages, and case narratives for all other analyses.

Data reports for all parameters will include, at a minimum, the following items:

Narrative: Summary of activities that took place during the course of sample analysis, including the following information:

- Laboratory name and address;
- Date of sample receipt;
- Cross reference of laboratory identification number to contractor sample identification;
- Analytical methods used;
- Deviations from specified protocol; and
- Corrective actions taken.

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results: Reported according to analysis type and including the following information, as acceptable:

- Sample ID;
- Laboratory ID;
- Date of collection;
- Date of receipt;
- Date of extraction;
- Date of analysis; and
- Detection limits.

Sample results on the report forms will be corrected for dilutions. Sediment samples will be reported on a dry weight basis. Unless otherwise specified, results will be reported uncorrected for blank contamination.

The data for total and methyl mercury analyses will be expanded to include supporting documentation necessary to provide a CLP-equivalent package. This additional documentation will include, but is not limited to, raw data required to recalculate any result, including instrument printouts and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

6.6 Project File

Project documentation will be placed in a single project file at the BBL office in Syracuse, New York. This file will consist of the following components:

1. Agreements (filed chronologically);
2. Correspondence (filed chronologically);
3. Memos (filed chronologically); and
4. Notes and data (filed by topic).

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation (when received) and field data will be filed with notes and data. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.

7. Sampling Process Design

The sampling process for the work described in the SRAMP is based on a grid sampling design. The number of samples was determined through selecting a grid size that would spatially represent an adequate proportion of the Borrow Pit Lake substrate. The size of each grid for the Borrow Pit Lake sediment characterization is 200 feet by 200 feet at locations of Borrow Pit Lake that are downstream of the confluence of Dead Creek (Creek Segment F). A 300 foot grid will be used in portions of the Borrow Pit Lake that are upstream of the Creek Segment F confluence.

Prior to sampling a basemap of the grid overlay on to Borrow Pit Lake will be used by a BBL survey team to place grade stakes at locations where grids bisect. This survey will allow the sediment sampling team to identify approximate locations within each grid where sediment samples will be collected. As mentioned in Section 3, the actual location of samples will be recorded with DGPS.

8. Sampling Method Requirements

As part of the field investigations, several standard field procedures will be performed. They include:

- Sediment core collection and characterization;
- Surface sediment sampling; and
- Subsurface sediment sampling.

This section of the QA/SAPP introduces and references the appropriate detailed procedure in the Appendices to this QA/SAPP. Included are the ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments. Sample handling, packing, and shipping are discussed in Section 9. Sample quantities and analytical constituents and parameters for the following sections are summarized in Table 1. The required sample containers, volumes, preservation, and holding times are summarized in Table 4. Sampling Equipment and Procedures

8.1 Sampling Equipment and Procedures

8.1.1 Sediment Sampling

Sediment samples will be collected utilizing clear Lexan® tubing. Probing and sediment sampling activities will be conducted utilizing the materials and procedures provided in Appendix A. Sediment samples will be collected at discrete intervals and analyzed, as discussed in Section 8.2.3. Samples will be thoroughly mixed prior to placement in sample containers for laboratory analysis. The sediment samples will be shipped to the laboratory following the protocols set forth in Appendix B. Equipment will be thoroughly cleaned between sample locations as described in Appendix C. Materials and wastes (i.e., sediment, water, disposable equipment, etc.) generated during implementation of the SRA will be collected and disposed of appropriately, as discussed in Section 9.4.

8.1.2 Survey of Sample Locations

Sample locations and transect end points will be surveyed and documented so that they can be located at a later date, if necessary. Conventional surveying equipment and techniques combined with Differential Global

Positioning System (DGPS) technology will be used to tie the locations to permanent reference points. The sample locations and cross-section delineations will be incorporated into a base map that will be used for future sampling and presentations.

8.1.3 Sediment Characterization

At each location, sediment probing will be conducted with metal rods and hand-coring equipment. Soft sediment areas penetrable by a metal rod will be considered sediment deposits and will be sampled with a clear Lexan® tube for visual inspection. The Lexan® tubing will be hand-driven until refusal. Each core will be described and distinct strata within the cores will be classified according to the Unified Soil Classification System (USCS). In addition to visual inspection and description, cores will be photographed along with an identification sheet. All locations will be surveyed using conventional ground survey techniques or GPS technology.

For each sample collection point, the following information will be obtained and recorded:

- Surveyed location;
- Depth of sediment (depth of refusal);
- Depth of water;
- Description of the bank slope and condition (with respect to erosion);
- USCS description(s) of sediment layer(s);
- Secondary sediment descriptions (i.e., color, odor, presence of debris, types of materials);
- Physical features of the river, including a description of the river bottom; and
- Other appropriate field conditions and observations.

9. Sample Handling and Custody Requirements

9.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for SRA samples are shown in Table 4.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned according to USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate). Sample labeling procedures are described in Appendix B.

9.2 Field Custody Procedures

The objective of field sample custody is to assure that samples are not tampered with from the time of sample collection through time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field COC forms.

9.2.1 Field Logbooks

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned;
- Logbook number;
- Project name;
- Project start date; and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in Section 8. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

9.2.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required on each sample label:

- Project;
- Date collected;
- Time collected;
- Location;

- Sampler;
- Analysis to be performed;
- Preservative; and
- Sample number.

9.2.3 Field Chain of Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express) or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. The labels will include sample information such as: sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate COC will be prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

9.3 Management of Investigation Derived Materials and Wastes

Disposable equipment, debris and decontamination rinsate (e.g., distilled water containing small amounts of solvent) will be containerized during the sampling events and labeled for appropriate disposal.

9.4 Packing, Handling and Shipping Requirements

Sample packaging and shipment procedures are designed to insure that the samples will arrive at the laboratory, with the COC, intact.

Samples will be packaged for shipment as outlined below:

- Ensure that sample containers have the sample labels securely affixed to the container with clear packing tape;
- Check the caps on the sample containers to ensure that they are properly sealed;
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose;
- Complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. NOTE: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer;
- Using duct tape, secure the outside drain plug at the bottom of the cooler;
- Wrap sample containers in bubble wrap or other cushioning material;
- Place 1 to 2 inches of cushioning material at the bottom of the cooler;
- Place the sealed sample containers into the cooler;
- Place ice in plastic bags and seal. Place loosely in the cooler;
- Fill the remaining space in the cooler with cushioning material;
- Place COC forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid;
- Close the lid of the cooler, lock, and secure with duct tape;
- Wrap strapping tape around both ends of the cooler at least twice; and
- Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating "this side up." Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will be hand-delivered or delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by

common carrier, a bill of lading will be used. Receipts or bil s of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Additional procedures for packing, handling, and shipping environmental samples are included in Appendix B.

9.5 Laboratory Custody Procedures

9.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field COC form will accompany all samples requiring laboratory analysis. The laboratory will use COC guidelines described in the USEPA guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

9.5.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field COC. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, BBL will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

9.5.3 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory COC form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days, and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix spike/matrix spike duplicate (MS/MSD) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. These rules for analysis will ensure that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons may be made.

9.5.4 Sample Storage Following Analysis

Samples will be maintained by the laboratory for one month after the final report is delivered to BBL. After this period, the laboratory is responsible for the disposal of the samples. Unused portions of the samples, samples extracts and associated wastes will be disposed of by the laboratory in accordance with applicable rules and regulations as specified in their Standard Operating Procedure for waste disposal.

10. Analytical Method Requirements

10.1 Field Parameters and Methods

Field data will be corrected for pH, temperature and conductivity.

10.2 Laboratory Parameters and Methods

The methods listed below include the range of analyses expected to be performed.

10.2.1 Sediment Samples

Surface sediment samples from all grids and subsurface sediment samples from the odd-numbered grids will be analyzed for:

Total Mercury	USEPA SW-846 Method 7471
Methyl Mercury	USEPA Method 1630 (modified)

11. Quality Control Requirements

11.1 Quality Assurance Indictors

The overall quality assurance objective for this QA/SAPP is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventive maintenance, and corrective action, such that valid data will be generated. These procedures are presented or referenced in the following sections of the QA/SAPP. Specific QC checks are discussed in Section 11.2.

Quality assurance indicators are generally defined in terms of five parameters:

1. Representativeness;
2. Comparability;
3. Completeness;
4. Precision; and
5. Accuracy.

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP as referenced below.

11.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. The actions have been designed to assess the presence of the chemical constituents at the time of sampling. The Site SRAMP presents the rationale for sample quantities and location. This QA/SAPP presents field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

11.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QA/SAPP and through the use of established QA/QC procedures, and the utilization of appropriately trained personnel.

11.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 11.6.

11.1.4 Precision

Precision is a measure of the reproductability of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QA/SAPP. Checks for analytical precision will include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Section 11.4.

11.1.5 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

11.2 Field Quality Control Checks

11.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location.

11.2.2 Sample Containers

Certified-clean sample containers (I-Chem 300 Series or equivalent) will be supplied by the laboratory Certificates of analysis will be filed in the project file.

11.2.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. Field duplicates will be prepared by placing well homogenized aliquots from the same sample location into individual sample containers, which are submiite blind to the laboratory. In general, field duplicates will be analyzed at a 5 percent frequency (every 20 samples) for the chemical constituents. Table 1 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

11.2.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis once per day per matrix. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) which has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. Table 1 provides an estimated number of rinse blanks for environmental media samples to be collected during the removal action.

11.3 Analytical Laboratory Quality Control Checks

11.3.1 General

Internal laboratory quality control checks will be used to monitor data integrity. These checks will include method blanks, matrix spikes (and matrix spike duplicates), spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project QC limits for duplicates and matrix spikes are identified in Table 2. Laboratory control charts will be used to determine long-term instrument trends.

11.3.2 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources which could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

11.3.3 Matrix Spikes/Matrix Spike Duplicates

Matrix spikes and matrix spike duplicates will be used to measure the accuracy of analyte recovery from the sample matrices. Matrix spikes and matrix spike duplicates will be site-specific. Matrix spike duplicate pairs will be analyzed at a 5 percent frequency (every 20 samples or once every week, whichever comes first).

When matrix spike recoveries are outside QC limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results. Table 1 presents an estimated number of matrix spike and matrix spike duplicate analyses for each applicable matrix and parameter.

11.3.4 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours, or more frequently as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, then samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods as summarized in Section 13.

11.3.5 Reference Standards/Control Samples

Reference standards are standards of known concentration, and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

11.4 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision will be monitored through the use of matrix spike/matrix spike duplicate sample analyses.

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements

B = Analytical result from the second measurement

Precision objectives for duplicate analyses are identified in Table 2.

11.5 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spikes, surrogate spikes and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard

X = Value measured in original sample

B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for matrix spike recoveries are identified in Table 2.

11.6 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

12. Instrument/Equipment Testing, Inspection and Maintenance Requirements

12.1 General

Testing and maintenance schedules have been developed for both field and laboratory instruments. A summary of the testing and maintenance activities to be performed is presented below.

12.2 Field Instruments and Equipment

Prior to field sampling, each piece of field equipment will be inspected to assure it is operational. If the equipment is not operational, it must be serviced prior to use. Meters which require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the appropriate Task Manager or field personnel to follow the maintenance schedule and arrange for prompt service.

Field instrumentation to be used in this study includes meters to measure pH, conductivity, dissolved oxygen, turbidity, redox potential and temperature. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The BBL Task Managers will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters.

12.3 Laboratory Instruments and Equipment

12.3.1 General

Laboratory instrument and equipment documentation procedures are provided in the laboratory Quality Assurance Manual (to be provided). Documentation includes details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

12.3.2 Instrument Maintenance

Maintenance schedules for laboratory equipment adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures are performed through service contracts with manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

13. Instrument Calibration and Frequency

13.1 Field Instruments and Equipment

Field personnel are responsible for ensuring that a master calibration/maintenance log is maintained following the procedures specified for each measuring device. Each log will include, at a minimum where applicable:

- Name of device and/or instrument calibrated;
- Device/instrument serial/identification number;
- Frequency of calibration;
- Date(s) of calibration(s);
- Results of calibration(s); and
- Name of person(s) performing calibration(s).

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during the field sampling will be examined to certify that it is operating condition. This includes checking the manufacturer's operating manual to ensure that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to insure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out.

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a pH meter, thermometer, nephelometer, and specific conductivity meter. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned on the manufacturer for service.

Calibration of field instruments is governed by the specific Standard Operating Procedures (SOPs), Appendix D, for the applicable field analysis method, and such procedures take precedence over the following general discussion.

pH Calibration

The pH meter will be calibrated with standard buffer solutions prior to a field trip. In the field, the meter will be calibrated daily with two buffers before use. Thereafter, the meter will be checked against two buffer solutions which will be used for each field trip. Calibration procedures and frequency will be recorded in a field log book along with the lot numbers of the buffer. The temperature of sample and buffer should be the same. The calibration procedure is described below.

- Connect pH electrode into pH meter and turn on pH meter.
- Set temperature setting based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust "CALIB" knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the sample and record the pH as displayed.
- Remove pH electrode from sample and rinse off with distilled water.
- The pH meter must be recalibrated every time it is turned off and turned back on, or if it starts giving erratic results.

The calibrations performed, standard used, and sample pH values are to be recorded in the field notebook. New batteries will be kept with the meters to facilitate immediate replacement in the field as necessary.

Temperature Calibration

Temperature measurements are carried out utilizing a thermometer The thermometers must be inspected before use to ensure there is no mercury separation. The thermometers should be rechecked in the field before and after use to see if the readings are logical and the mercury is still intact. The thermometers will be checked biannually for calibration, by immersing them in a bath of known temperature until equilibrium is reached. They will be discarded if found to have more than 10% error. The reference thermometer used for the bath calibration will be National Bureau of Standards (NBS) traceable.

Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards before each field trip. In the field, the instrument will be checked daily with NBS traceable standards. The calibration procedure is described below.

- Place the probe in conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of calibration standard.
- Rinse off the electrode with distilled water.
- Measure the conductivity for distilled water to be used for a field blank, making sure temperature is set correctly for temperature of solution to be tested.
- If the conductivity of blank (distilled water) is high, it must be discarded and a new blank sample procured.

All readings and calibrations are recorded in the field notebook.

13.2 Laboratory Instrument and Equipment

When analyses are conducted according to the USEPA SW-846 methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to QA audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All standards used in the calibration of equipment are traceable, directly or indirectly, to National Institute of Standards and Technology (NIST). All standards received are logged into standard receipt logs maintained by the individual analytical groups. Each group maintains a standards log which tracks the preparation of standards used for calibration and QC purposes.

Total Mercury (Method 7471)

Atomic absorption instruments are calibrated using a minimum of three standards and a blank. The initial calibration is verified prior to the analysis of samples by an initial calibration verification standard (ICV). The recovery of this standard must be between 90 and 110 percent for the initial calibration to be considered valid.

Continuing calibration verification (CCV) standards are analyzed every 10 samples. The recovery of this standard must be between 80 and 120 percent. In addition, a final CCV must be analyzed at the end of the analytical sequence. Recovery of this standard must also be between 80 and 120 percent. If any of the CCVs (including the final CCV) fail to meet method specifications, all samples analyzed since the last compliant standard must be reanalyzed for the failed analyte(s).

Methyl Mercury (Method 1630)

The Cold Vapor Atomic Florescence Spectrometer (CVAFS) is calibrated by analysis of standard solutions at five concentration levels as well as an ethylation blank. The standard responses are corrected for blank content and the calibration factors (CFs) are determined using a response versus concentration calculation. If the percent relative standard deviation (% RSD) for the calibration factors is less than 15% and if the recovery of the lowest standard is between 65 and 135%, the curve is considered valid and analysis may begin.

Continuing calibration verification standards are run every 12 hours, or every 20 samples, whichever is more frequent. If the recovery of the CCV is within 77 and 123%, the continuing calibration is considered valid and analysis may continue. A CCV must be analyzed at the end of the analytical sequence. The recovery of this standard must also be within 77 and 123%. If any of CCV (including the final CCV) fail to meet method specifications, all samples analyzed since the last compliant standard must be reanalyzed.

14. Inspection/Acceptance Requirements for Supplies and Consumables

Inspection/acceptance requirements for supplies and consumables will be as specified in the laboratory Quality Assurance Manual (to be provided).

15. Data Acquisition Requirements for Nondirect Measurements

Prior to their use, historic data sets will be reviewed according to the procedures identified in subsequent sections of this QA/SAPP to determine the appropriate uses of such data. The extent to which these data can be validated will be determined by the analytical level and QC data available. The evaluation of historic data for SRA purposes requires the following:

- Identification of analytical levels;
- Evaluation of QC data, when available; and
- Development of conclusions regarding the acceptability of the data for intended uses.

Acceptability of historic data for intended uses will be determined by application of these procedures and professional judgment. If the historic data quality cannot be determined, its use will be limited to general trend evaluations.

16. Data Management

The purpose of the data management is to ensure that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will encompass a large number of samples and a variety of sample matrices and analytes from a large geographic area. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

As outlined in the SRAMP, sampling activities will include analyses for total and methyl mercury. The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements: 1) sample designation system, 2) field activities, 3) sample tracking and management, 4) data management system, and 5) document control and inventory.

16.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sampled collected, as outlined in Section 6.2.1.

16.2 Field Activities

Field activities designed to gather the information necessary to make decisions regarding the off-site areas require consistent documentation and accurate record keeping. During site activities, standardized procedures

will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

16.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To ensure that the field investigation is thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- Field logs;
- Instrument calibration records; and
- Chain-of-custody forms.

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the remedial investigation. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To ensure at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed to accurately record their locations. The survey crew will use their own field logs and will supply the sampling location coordinates to the File Custodian.

Instrument Calibration Records

As part of data quality assurance procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration ensures that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 13.1. To demonstrate that established

calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- Calibration date and time;
- Type and identification number of equipment;
- Calibration frequency and acceptable tolerances;
- Identification of individual(s) performing calibration;
- Reference standards used;
- Calibration data; and
- Information on calibration success or failure.

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Chain-of-Custody Forms

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the COC procedure. A more thorough description of the COC forms are located in the SOPs (Appendix B).

16.2.2 Data Security

Measures will be taken during the field investigation to ensure that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office or locked in the field vehicle overnight. Access to these files will be limited to the field personnel who utilize them.

16.3 Sample Management and Tracking

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms, as described in Appendix B and summarized in Section 9.3.3. On a daily basis, the completed COC forms associated with samples collected that day will be faxed from the project office to the QAM. Copies of all completed COC forms will be maintained in the field office. On the following day, the QAM will telephone the laboratory to verify receipt of samples.

When analytical data are received from the laboratory, the QAM will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed-up by the QAM.

16.4 Data Management System

In addition to the sample tracking system, a data management system will be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Database Administrator, will combine pertinent geographical, field, and analytical data. Information that will be used to populate the database will be derived from three primary sources: surveying of sampling locations, field observations, and analytical results. Each of these sources is discussed in the following sections.

16.4.1 Computer Hardware

The database will be constructed on Pentium®-based personal computer work stations connected through a Novell network server. The Novell network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners, modems, etc. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

16.4.2 Computer Software

The database will be written in Microsoft Access, running in a Windows operating system. Custom applets, such as diskette importing programs, will be written in either Microsoft VBA or Microsoft Visual Basic. Geographic Information System (GIS) applications will be developed in ERSI ArcView, with additional customization performed with Visual Basic. Tables and other database reports will be generated through Access

in conjunction with Microsoft Excel, Microsoft Word, and/or Seagate Crystal Reports. These software products will be upgraded to current industrial standards, as necessary.

16.4.3 Survey Information

In general, each location sampled as part of the SRA will be surveyed to ensure accurate documentation of sample locations for mapping and GIS purposes, to facilitate the re-sampling of select sample locations during future monitoring programs, if needed, and for any additional activities. The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sample locations, as appropriate. All field books associated with the surveying activities will be stored as a record of the project activities.

Conventional surveying techniques will be used to gather information such as the angle and distance between the sample location and the control monument, as well as point attributes. This information will be digitally stored in a data logger attached to the total station. On a regular basis, each data logger in use will be transferred to the BBL Syracuse, New York office, where the information will be downloaded into a personal computer for processing with surveying software. Control monuments will be established using GPS techniques. The surveying software allows the rapid computation of a location's state plane coordinates.

Differential leveling techniques will be used to gather information to be used to compute a sample location's elevation. During the differential leveling process, which includes at least one benchmark of known elevation, detailed field notes will be kept in a field book. On a weekly basis, a copy of the relevant pages will be forwarded to the Syracuse, New York office, where the relevant information will be manually keyed into BBL's surveying software package for further processing. The surveying software reduces the field notes and calculates a location's elevation relative to the project datum.

Following computation of a location's state plane coordinates and, at select locations, elevations, the computer information will undergo a QA/QC review by a licensed land surveyor. Following the approval of the computed information, the coordinates and elevations will be transferred to the File Custodian both in a digital and a hard copy format. This data will then be loaded into the database and linked to the field and analytical data.

16.4.4 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field. Figure 2 depicts the general data flow of the field observations from sample collection through inclusion n the data management system.

Following each sampling event, a status memorandum will be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to present a summary and a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Status memos are tools used to keep project personnel informed on the details of the field activities and are also invaluable during the development of the final report. Each status memo will be reviewed for accuracy and completeness by the respective sampling activity manager. Following the approval and finalization of each memo, the status memo will be used to transfer field observations into the data management system.

16.4.5 Analytical Results

Analytical results will be provided by the laboratory in both a digital and a hard copy format. Upon receipt of each analytical package, the original COC form will be placed in the project files. The data packages will be examined to ensure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the QAM will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package will be validated in accordance with the procedures presented in Section 20.1. Any data that does not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation, the digital files will be usedto populate the appropriate database tables. An example of the format of electronic data deliverable (EDD) format is included in Table 15. This format specifies one data record for each constituent for each sample analyzed. Specific fields include:

- Sample identification number;
- Date sampled;
- Date analyzed;
- Parameter name;
- Analytical result;
- Units;
- Detection limit; and
- Qualifier(s).

The individual EDDs, supplied by the laboratory in either an ASCII comma separated value (CSV) format or in a Microsoft Excel worksheet, will be loaded into the appropriate database table via a custom-designed user interface Visual Basic program. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

16.4.6 Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of the SRA data. Routines have been developed to permit the user to scan analytical data from a given site for a given media. Several output functions are also available which can be modified, as necessary, for use in the data management system.

A valuable function of the data management system will be the generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates a digital file of analytical results and qualifiers for a given media. The file can then processed into a table of rows and columns which can be transferred to word processing software (e.g., Microsoft Word) for final formatting and addition of titles and notes. Tables of analytical data will be produced as part of data interpretation tasks and the reporting of data to USEPA.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/presentation software. A function has been created by BBL that creates a digital

file consisting of sample location number, state plane coordinates, sampling date, and detected constituents and associated concentrations and analytical qualifiers. The file is then transferred to an AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

16.4.7 Document Control and Inventory

BBL maintains project files in its Syracuse, New York office. Each client project is assigned a file/job number. Each file is then broken down into the following subfiles:

#1- Agreements and Contracts - all agreements and contracts involving the off-site investigations;
#2- Correspondence - all external correspondence, including reports;
#3- Memoranda - all internal and external memoranda;
#4- Notes and Data - notes and data from field, laboratory, and internal calculations; and
#5- News Clippings - local newspapers, USEPA publications, and technical publications are sources of articles.

Originals, when possible, are placed in the files. These are the central files and will serve as the site-specific files for the off-site investigations.

17. Assessment and Response Actions

17.1 General

Performance and systems audits will be completed in the field and laboratory during the SRA as described below.

17.2 Field Audits

The following field performance and systems audits will be completed during this project.

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The BBL QAM will review field reports and communicate concerns to the BBL Project Manager and/or Task Managers, as appropriate. In addition, the BBL QAM will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures. In addition, systems audits comparing scheduled QA/QC activities from this document with actual QA/QC activities completed will be performed. The appropriate Task Manager and QAM will periodically confirm that work is being performed consistent with this QA/SAPP and the SRAMP.

17.3 Laboratory Audits

Internal laboratory audits will be conducted as specified in the laboratory's QA manual (to be provided). As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory's Quality Assurance Manual and SOPs. A systems audit of each laboratory is also performed to determine if the procedures implemented by each laboratory are in compliance with the quality assurance plan.

In addition to the laboratory's internal audits and participation in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation,

analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

BBL reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

17.4 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QA/SAPP or the SRAMP. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

17.4.1 Field Procedures

When conducting the action field work, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Form and reported to the appropriate BBL Task Manager, QAM, and Project Manager.

Examples of situations that would require corrective actions are provided below:

- Protocols as defined by the QA/SAPP and SRAMP have not been followed;
- Equipment is not in proper working order or is not properly calibrated;
- QC requirements have not been met; or
- Issues resulting from performance or systems audits have not been resolved.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

17.4.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented and reported to the appropriate project manager and QAM.

Corrective action may be initiated, at a minimum, under the following conditions:

- Protocols as defined by this QA/SAPP have not been followed;
- Predetermined data acceptance standards are not obtained;
- Equipment is not in proper working order or calibrated;
- Sample and test results are not completely traceable;
- QC requirements have not been met; or
- Issues resulting from performance or systems audits have not been resolved.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities. For all instrument systems, corrective action is initiated at a point were the problem has been identified. At whatever level this occurs (analyst, supervisor, data review, or quality control), it is brought to the attention of the QA Manager and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director.

Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, re-analysis, cleanup, dilutions, matrix modifications, or other activities.

18. Reports to Management

The QAM will audit the implementation of the QA/SAPP. Each project component will result in some type of QA report or, by its absence, acknowledge that no significant QA or QC deviations occurred. Items that may result in a QA report include:

- Changes or updates to the QA/SAPP;
- Deviations from QA/SAPP or SRAMP specification;
- The results of system and performance audits;
- Significant QA/QC problems, recommended solutions, and the results of corrective actions; and
- Limitations on the use of measurement data.

18.1 Field Reports

Reporting of the quality of field sample collection and field measurements will be the responsibility of the Field Supervisor or designee. Information from the field logbooks will be compiled and a summary report on field activity QA will be prepared for the project file.

18.2 Laboratory Reports

The laboratory will maintain QA records related to analyses, quality control, and corrective action. This information will be made available to the Project Manager upon request. Routine reporting will include documenting of all internal quality control checks performed for this project.

19. Data Review, Validation and Verification

19.1 General

After field and laboratory data are obtained, the data will be subject to the following:

1. Reduction, or manipulation mathematically, or otherwise into meaningful and useful forms;
2. Review;
3. Organization, interpretation, and reporting; and
4. Data validation.

19.2 Field Data Reduction and Review

19.2.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets, and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the SRAMP and this QA/SAPP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

19.2.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAM. Logs and documents will be checked for:

1. General completeness;
2. Readability;
3. Usage of appropriate procedures;
4. Appropriate instrument calibration and maintenance;
5. Reasonableness in comparison to present and past data collected;
6. Correct sample locations; and
7. Correct calculations and interpretations.

19.3 Laboratory Data Reduction and Review

19.3.1 Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

Inorganic analyses will be based on regression analysis. Regression analysis is used to fit a curve through the calibration standard data. The sample concentrations will be calculated using the resulting regression equations. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

19.3.2 Laboratory Data Review

Data will be subject to multi-level review by the laboratory. The group leader will review data reports prior to release for final data report generation. The QAM will review a random sample of 5 percent of the final data reports, and the laboratory director will review a cross section of the final data reports. Final data reports are reviewed by the Department Manager prior to shipment to BBL.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 17. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the BBL Project Manager.

19.4 Data Validation and Verification

All data generated will be subjected to the data validation and verification procedures outlined in Section 20.

20. Validation and Verification Methods

20.1 Data Validation and Verification

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results were correctly transcribed from the instrument read outs, and which, if any, environmental samples were related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

BBL will validate the total and methyl mercury analytical data using the most recent versions of the USEPA's Function Guidelines (USEPA, 1999, 2002) for data validation available at the time of project initiation, where appropriate. These procedures and criteria may be modified as necessary to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the data quality objectives. Data validation will include a review of completeness and compliance, including, but not limited to, the elements provided in Table 6.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QA/SAPP. Any deviations from the analytical method or any special reporting requirements apart from that specified in this QA/SAPP will be detailed on COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package;
- Verify that field COC forms were completed and that samples were handled properly;
- Verify that holding times were met for each parameter. Holding time exceedences, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis;
- Verify that parameters were analyzed according to the methods specified;

- Review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and matrix spike recoveries are acceptable);
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the project manager and/or laboratory manager, as appropriate; and
- If data appears suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics as applicable to each method:

- Assessment of the data package;
- Description of any protocol deviations;
- Failures to reconcile reported and/or raw data;
- Assessment of any compromised data;
- Laboratory case narrative;
- Overall appraisal of the analytical data; and
- Table of site name, sample quantities, matrix, and fractions analyzed.

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the BBL QAM at this point.

Data validation reports will be kept in the project file at the BBL office in Syracuse, New York.

21. Reconciliation with User Requirements

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Action options may include any or all of the following:

- Retrieval of missing information;
- Request for additional explanation or clarification;
- Reanalysis of sample from extract (when appropriate); and
- Recalculation or reinterpretation of results by the laboratory.

These actions may improve the data quality, reduce uncertainty, and may eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following actions may be taken:

- Extrapolation of missing data from existing data points;
- Use of historical data; and
- Evaluation of the critical/non-critical nature of the sample.

If the data gap can not be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, then the following action must be taken:

- Additional sample collection and analysis.

Acronyms and Abbreviations

ASTM	American Society for Testing and Material
BBL	Blasland, Bouck & Lee, Inc.
CCV	Continuing Calibration Verification
CFs	Calibration Factors
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CSV	Comma Separated Value
CVAFS	Cold Vapor Atomic Fluorescence Spectrometer
DGPS	Differential Global Positioning System
DUP	Duplicate
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
GIS	Geographic Information System
ICB	Initial Calibration Blank
ICV	Initial Calibration Verification
mg/kg	Milligrams per kilogram
mS/cm	Millisiemens per centimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NBS	Nations Bureau of Standards
NEIC	National Enforcement Investigations Center
NIST	National Institute of Science and Technology
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppb	Parts per billion
ppm	Parts per million
QAM	Quality Assurance Manager
QA/SAPP	Quality Assurance/Sampling and Analysis Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation Recovery Act
RSD	Relative Standard Deviation
SDG	Sample Delivery Group
Solutia	Solutia Inc.
SOP	Standard Operating Procedures
SRA	Sediment Removal Action
SRAMP	Sediment Removal Action Mitigation Plan
TSCA	Toxic Substances Control Act
TSP	Trisodium phosphate
SU	Standard Units
USCS	Unified Soil Classification System
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency

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Figures

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NOTES:

1. 200 FT. SAMPLING GRID DOWNSTREAM OF DEAD CREEK CONFLUENCE.
2. 300 FT. SAMPLING GRID UPSTREAM OF DEAD CREEK CONFLUENCE.
3. BASE MAP INFORMATION OBTAINED FROM SOLUTIA INC., 11/11/02.

0 200' 400'
GRAPHIC SCALE

SOLUTIA INC.
SAUGET, ILLINOIS
SAUGET AREA 1

SITE LOCATION MAP

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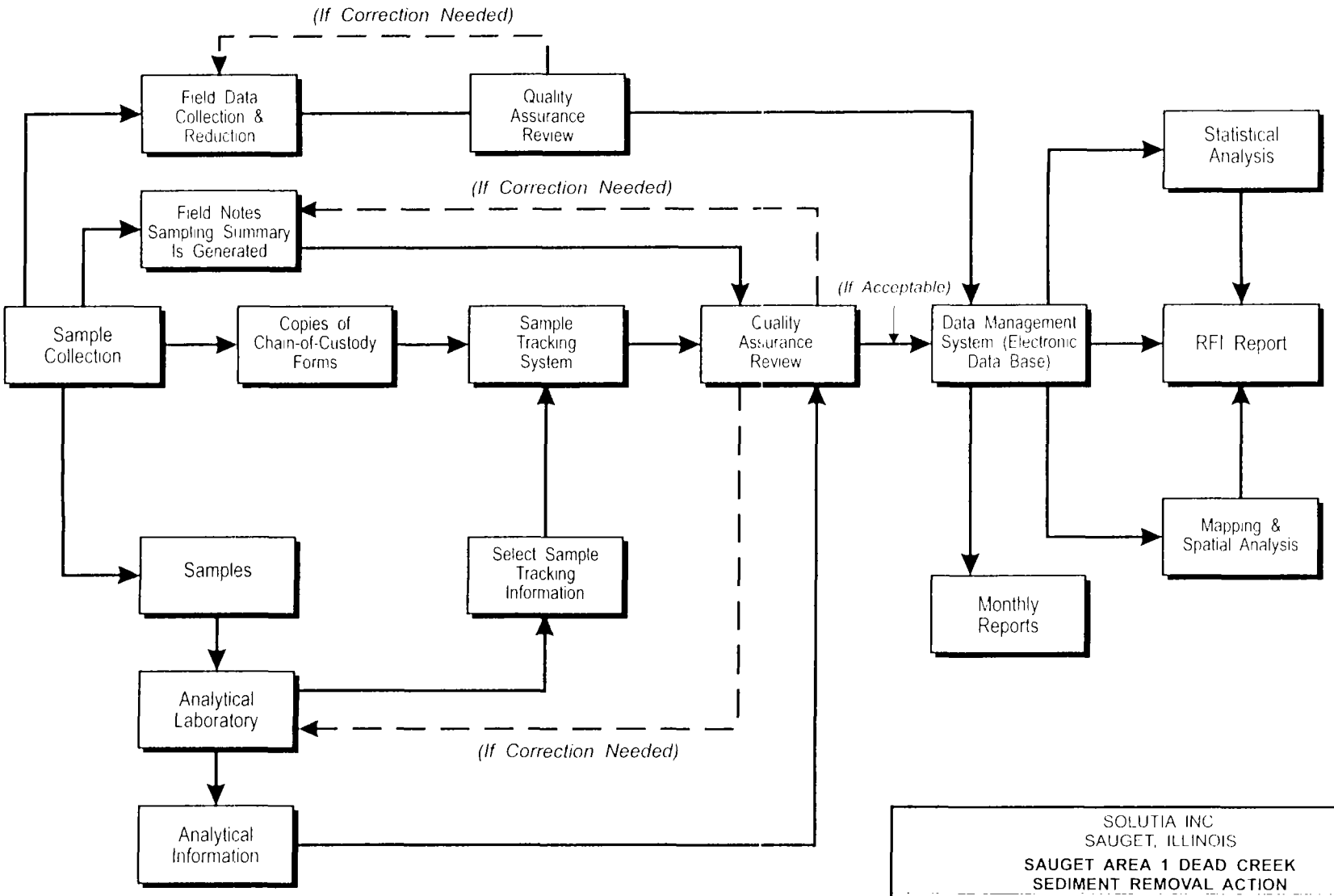
FIGURE
1

X: 10285X01.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT=DL
11/14/02 SYR-54-DJP LJP
10285020/10285G01.DWG



SOLUTIA INC
SAUGET, ILLINOIS
SAUGET AREA 1 DEAD CREEK
SEDIMENT REMOVAL ACTION

DATA MANAGEMENT FLOW CHART

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FIGURE
2

11/08/02 SYR D:\4 DJH
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Tables

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Table 1

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Environmental and Quality Control Analyses

Parameter	Estimated Environmental Sample Quality	Field QC Analyses						Laboratory QC Sample						Total
		Trip Blank		Rinse Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Surface Sediment														
Total Mercury	60	NA	--	1/day	7	1/20	3	1/20	3	1/20	3	NA	--	76
Methyl Mercury	60	NA	--	1/day	7	1/20	3	1/20	3	1/20	3	NA	--	76
Subsurface Sediment														
Total Mercury	30	NA	--	1/day	7	1/20	2	1/20	2	1/20	2	NA	--	43
Methyl Mercury	30	NA	--	1/day	7	1/20	2	1/20	2	1/20	2	NA	--	43

Notes
1/day One rinse blank per day or one per 20 samples, whichever is more frequent
Freq Frequency
NA Not Applicable
No Number
QC Quality Control

Table 2

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Analytical Quality Control Limits[1]

Parameter	Accuracy - % Recovery		Precision - RPD	
	MS/MSD	Surrogate	MS/MSD	Duplicate[2]
Sediment				
Total Mercury	80-120	--	30	--
Methyl Mercury	75-125	--	25	--

Notes:

1 The listed QC limits are based on USEPA guidance and are advisory. However, frequent failures to meet the QC limits warrant investigat on of the laboratory

2 Duplicate control limits apply to laboratory duplicates.

MS Matrix Spike
MSD Matrix Spike Duplicate
RPD Relative Percent Difference

Table 3

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Parameters, Methods and Target Reporting Limits

Analyte	Method[1]	Reporting Limit		
		Sediment	Water	Biota
Total Mercury	7471[1]	0.02 mg/kg	--	--
Methyl Mercury	1630[2]	0.00.001 mg/kg	--	--

Notes:

1 USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste* SW-846 3rd ed. Washington, D.C. 1996.

2 USEPA. Office of Science and Technology. *Methyl Mercury in Water by Distillation, Aqueous Ethylation, Pugeal Trap, and CVAFS.* EPA-821-R-01-020. 2001

Table 4

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Sample Containers, Preservation, and Holding Times

Parameter	Method[1]	Bottle Type	Preservation	Holding Time[2]
Sediment				
Total Mercury	SW-846-7471	250 ml plastic or glass jar	Cool to 4°C	28 days to analysis
Methyl Mercury	USEPA 1630	125 ml glass jar with Teflon®-lined lid	Cool to 4°C minimize headspace	48 hours to analysis

Notes:

1 USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste.* SW-946 3rd ed. Washington, D.C. 1996; and

USEPA. Office of Science and Technology. *Methyl Mercury in Water by Distillation, Aqueous Ethylation, Pugeal Trap, and CVAFS*. EPA-821-R-01-020. 2001

2 All holding times are measured from date of collection.

Table 5

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Electronic Data Deliverable Format

Field Name	Maximum Length	Data Type	Comments
SAMPLEID	20	TEXT	
SDG	20	TEXT	
LABSAMPLEID	30	TEXT	
QAQTYPE	40	TEXT	FIELD DUP, DILUTION, REANALYSIS, TRIP BLANK, etc.
LABMETHOD	50	TEXT	
PARAMETER	100	TEXT	
SAMPLEDATE	10	DATE	MM/DD/YY
EXTRACTDATE	10	DATE	MM/DD/YY
ANALYSISDATE	10	DATE	MM/DD/YY
CASNO	40	TEXT	
RESULTS	20	NUMERIC	Numeric Results ONLY
TEXTRESULTS	100	TEXT	Used for non-numeric results
DILUTION	20	NUMERIC	Dilution factor
DETECTLIMIT	20	NUMERIC	
CONCUNITS	20	TEXT	
LABQUALIFIER	10	TEXT	
VALQUALFIER	10	TEXT	
COMMENTS	256	TEXT	

Notes:

This definition is for comma separated value (CSV) format. Text data must be in double quotation marks. Numeric data and dates do not need double quotes.

Table 6

Solutia Inc.
Sauget Illinois
Sauget Area 1 - Dead Creek Sediment Removal Action

Data Validation Checklist

Review for Completeness	
1.	All chain-of-custody forms included.
2.	Case narratives.
3.	QA/QC summaries of analytical data including supporting documentation.
4.	All relevant calibration data including supporting documentation.
5.	Instrument and method performance data.
6.	Documentation showing laboratory's ability to attain specified method detection limits.
7.	Data report forms of examples for calculations of concentrations.
8.	Raw data used in identification and quantification of the analysis required.
Review of Compliance	
1.	Data package completed as described above.
2.	QAPP requirements for data production and reporting have been met.
3.	QA/QC criteria have been met.
4.	Instrument type and calibration procedures have been met.
5.	Initial and continuing calibration have been met.
6.	Data reporting forms are completed.
7.	Problems and corrective actions documents.

Appendices

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Appendix A
Sediment Sampling Procedures

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APPENDIX A

Sediment Sampling Procedures

I. Introduction

The general procedures to be utilized in obtaining sediment samples from the Creek are outlined below. Lexan® tubing will be the primary method used to collected sediment cores, the tubing may be replaced with a calibration rod if just probing is being performed. If the Creek bed cannot be penetrated by the Lexan® tubing due to large cobble, boulders, or bedrock, an attempt will be made using a standard split-spoon sampler or a stainless steel bucket auger.

Following collection, the sediment is placed into a container of inert material, homogenized and transferred to the appropriate sample containers.

II. Materials

- Personal protective equipment (as required by the Health and Safety Plan);
- Cleaning equipment (as required in Appendix C);
- Boat;
- Stainless steel tray;
- Duct tape;
- Lexan® tubing with end caps;
- Stainless steel sediment coring device;
- Stainless steel core driver;
- Calibrated rod for sediment depth measurement;
- Stainless steel spatula;
- T-handle;
- Extension rods;
- Hacksaw;
- Six-foot rule or survey rod;
- Stainless steel or plastic ruler;

- Stainless steel spoons;
- Stainless steel mixing bowl;
- Camera;
- Transport container with ice;
- Appropriate sample containers and forms; and
- Field notebook.

III. Procedures for Lexan® Tube Sampling

1. Identify the proposed sampling location in the field notebook along with other appropriate information collected during sediment sampling activities.

2. Don personal protective equipment.

3. Position boat over the sampling location and record station position.

4. Assemble the coring device by inserting the stainless steel core in to the sampling tube.

5. Insert the "eggshell" check valve mechanism into the tip of the sampling tube with the convex surface positioned inside the core tubing.

6. Screw the coring point onto the tip of the sampling tube.

7. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.

8. Lower the sampler into a perpendicular position on the sediment to be sampled. Measure the depth of water.

9. Using the T-handle, push the sampler by hand until refusal. Measure the depth of sediment. If the procedure is being performed to determine sediment depth (probing), a calibrated rod may be used in place of the sampling tube.

10. Rotate the sampler to shear off the core at the bottom and retrieve the device.

11. Keeping the device upright, cap the bottom of the sampling tube, slide the core out of the sampling tube, and cap the top of the tube. Wipe the bottom end dry and seal with duct tape.

12. Measure the length of sediment recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat the coring procedure adjacent to the location attempted.

13. Transport the core sample to shore.

14. While still keeping the core upright, use a handsaw to make a horizontal cut in the tube approximately one inch above the sediment.

15. Re-cap the cut end of the tube, seal the cap with duct tape and mark this end "TOP."

16. Wipe the tube dry.

17. Place a completed sample label on the tube.

18. Record the following sediment characteristics in the field logbook:

    - Texture
    - Color
    - Presence of debris
    - Presence of an oily sheen
    - Biological structures
    - Odor

19. Record the following information on both the tube and on the cap: 1) sample number, 2) sampling date, and 3) sampling time.

20. Place the core upright in a container with ice.

21. Repeat the above procedures until all core samples are collected for the day.

22. Each sediment core will be extruded from the Lexan® tubing onto a stainless steel tray. The core will be then be photographed. The cores will be sectioned into a 0 to 6 inch depth increment and a 6 inch to bottom increment. The increments will be transferred individually to stainless steel mixing bowls and mixed thoroughly to obtain homogenous samples representative of the sampling intervals. Both the 0 to 6 inch and 6 inch to bottom intervals will be transferred to appropriate sampling containers for the odd numbered grid number, only the 0 to 6 inch interval shall be retained for the even numbered intervals.

23. Core sections may be frozen to facilitate sectioning when the sediment is extremely loose.

24. Samples will be stored in coolers on ice until transfer to the laboratory (to be received within 48 hours of sample collection). All sample containers will be labeled with: 1) site name, 2) project number, 3) grid number, 4) sample interval, 5) date, 6) time of collection, and 7) names of sampling personnel. All appropriate information will also be entered in to the field logbook.

25. Fill out chain of custody and handle, pack and ship in accordance with the procedures in Appendix B.

IV. Procedure for Sediment Probing

The metal calibration rod will be used to probe sediment depths. From a boat at each location, the water depth to sediment will be measured by probing with a surveyor's rod. The sediment depth will then be measured by pushing a calibrated 5/8 inch galvanized hollow pipe into the sediment until refusal using reasonable human force. The depth of the penetrated sediment will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed from the length of the entire rod. Location, depth, and time of measurement will be noted in the field logbook.

V. Survey

A field survey control program will be conducted using standard instrument survey techniques to document the sediment sampling locations.

Appendix B
Field Sample Packing, Handling, and Shipping Procedures

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Appendix B

Field Sample Packing, Handling, and Shipping Procedures

I. Handling

1. Fill in sample label with:

   - Sample type (sediment, soil, etc.);
   - Project number and site name;
   - Sample identification code and other sample identification information, if applicable;
   - Analysis required;
   - Date;
   - Time sampled;
   - Sample type (composite or discrete); and
   - Preservative added, if applicable.

2. Cover the label with clear packing tape to secure the label onto the container.

3. Check the caps on the sample containers to ensure that they are tightly sealed.

4. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.

5. Place a signed custody seal label over the cap such that the cap cannot be removed without breaking the custody seal.

6. Initiate chain-of-custody by designated sampling personnel responsible for sample custody (after sampling or prior to sample packing). Note: If the designated sampling person relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.

II. Packing

1. Using duct tape, secure the outside and inside of the drain plug at the bottom of the cooler that is used for sample transport.

2. Place each sample container or package in individual polyethylene bags (Ziploc® type) and seal.

3. Place one to two inches of vermiculite at the bottom of the cooler as a cushioning material.

4. Place the sealed sample containers and package upright in the cooler.

5. Repackage ice (if required) in small Ziploc® type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent addition of sufficient cushioning material.

6. Fill the remaining space in the cooler with packing material.

7. Place the completed chain-of-custody forms in a large Ziploc® type bag and tape the forms to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with duct tape.

9. Wrap strapping tape around both ends of the cooler at least twice.

10. Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels on the top and on one side, and arrows indicating "This Side Up" on two adjacent sides.

11. Place custody seals over the front right and back left of the cooler lid and cover with clear plastic tape.

III. Shipping

1. All samples will be hand delivered or delivered by an express carrier (e.g., Federal Express) within 48 hours or less from the date of sample collection.

2. The following chain-of-custody procedures will apply to sample shipping:

a. Relinquish the sample containers to the laboratory via express carrier. The signed and dated chain-of-custody forms should be included in the cooler. The express carrier will not be required to sign the chain-of-custody forms. The sampler should retain the express carrier receipt or bill of lading.

b. When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody forms by recording receipt of samples, and then check the sample identification numbers on the containers against the chain-of-custody forms.

Appendix C
Field Cleaning/Decontamination Procedures

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Appendix C

Field Cleaning/Decontamination Procedures

I. Materials

- Health and safety equipment (as required in the Health and Safety Plan);
- Distilled water;
- Non-phosphate soap (Alconox® or equivalent);
- Tap water;
- Appropriate cleaning solvent (e.g., nitric acid);
- Rinse collection plastic containers;
- Knife;
- Brushes;
- Aluminum foil;
- Garbage bags;
- Spray bottles;
- Ziploc® type bags; and
- Plastic sheeting.

II. Cleaning Procedures for Small Equipment and Sampling Devices

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.), will follow the decontamination procedures presented below:

   a. Non-phosphate detergent and distilled water brush wash;
   b. Distilled water rinse;
   c. Rinse equipment with solvent (dilute nitric acid);
   d. Distilled water rinse; and
   e. Allow to air dry and wrap in aluminum foil.

3. Cleaning/decontamination will be conducted in plastic containers that will be transported to each sampling location. These containers will also be used to collect all decontamination rinsate.

III. Cleaning Procedures for Large Equipment (if applicable)

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of large sampling equipment will follow the decontamination procedures presented below:

   Wash all large equipment with a high pressure water wash using a brush as deemed necessary, to remove any particles.

Appendix D
Field Instrument Calibration Procedures

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APPENDIX D

Field Instrument Calibration Procedures

I. pH Meter Calibration

a. Materials

- Personal protective equipment (as required by the Health and Safety Plan);
- 10.0, 7.0, 4.0 pH buffer solutions;
- Thermometer;
- Distilled water;
- Calibration and maintenance log; and
- Field notebook.

b. Calibration Procedures

1. Switch on instrument.

2. Connect electrode to meter and remove protective cap.

3. Rinse electrode with distilled water.

4. Measure and record temperature of buffer solution.

5. Immerse pH electrode in pH buffer 7.00, set the temperature control to that of buffer 7.00 and allow sufficient time for the electrode to stabilize. Adjust the Standardize Control for the correct readout.

6. Rinse the electrode with distilled water.

7. Immerse the pH electrode in buffer 4.00, set the temperature control to that of the buffer and allow sufficient time for the electrode to stabilize. Adjust the Slope Control for the correct readout.

8. Rinse the electrode with distilled water.

9. If the pH is expected or could be between 7.0 and 10.0, immerse the pH electrode in buffer 10.00, set the temperature control and allow sufficient time for the electrode to stabilize. Adjust the slope control for the correct readout.

10. Record calibration information on the instrument calibration log

c. Operation Procedures

1. Calibrate pH meter.

2. Rinse probe in distilled water.

3. Fill a disposable beaker with sample water.

4. Insert probe into sample beaker and obtain a reading. The meter will read between 0 and 14 in 0.001 increments.

5. Repeat Step 4.

6. Log results in field notebook. The reportable result is the average of the two readings.

7. Rinse probe in distilled water.

d. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, prob ems and repairs..

4. Have replacement meter available on-site or ready for overnight shipment if necessary.

5. Return meter to manufacturer for service as necessary.

6. Record maintenance information on instrument log.

II. Temperature/Conductivity Meter Calibration

a. Materials

- Beaker capable of submerging the entire probe in a calibration liquid standard;
- Calibration liquid standard (NaCl, 10000 mg/L or equivalent);
- Fine-end screw driver;
- Disposable plastic beakers;
- Distilled water;
- Calibration and maintenance log; and
- Field notebook.

b. Calibration Procedures

1. Be sure the probe is clean.

2. Soak the probe in distilled water for at least 30 minutes.

3. Remove the probe from the water and shake off excess.

4. Immerse the probe to beyond the vent holes in a disposable beaker sontining sodium chloride standatd solution. Agitate vertically to remove trapped air.

5. Immerse in water and repeat Steps 3 and 4 at least one more time.

6. Press the Power key and CND key. Verify that the LO BAT indicator does not appear.

7. Press the 2 milliSiemens per centimeter (mS/cm) range key.

8. Check the reading on display. It should be 1.990 mS/cm. If adjustment is needed, use a small screwdriver to adjust the CAL control next to the display. Counterclockwise adjustment increases the reading, clockwise decreases.

9. Record calibration information on the instrument calibration log

c. Operation Procedures

1. Calibrate the conductivity meter.

2. Rinse probe in distilled water.

3. Fill a disposable beaker with sample water.

4. Turn meter to read temperature of water and record.

5. Turn meter to the 2 mS/cm scale.

6. Insert probe into sample beaker and obtain a reading. The meter will read between 0 and 20 mS/cm in 0.001 increments.

7. Repeat Step 6.

8. Record results in the field notebook. The reportable result is the average of the two readings.

9. Rinse probe in distilled water.

d. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, problems and repairs..

4. Have replacement meter available on-site or ready for overnight shipment if necessary.

5. Return meter to manufacturer for service as necessary.

7. Record maintenance information on instrument log.

Attachment

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